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3GPP2 S.R0005-B

Version 2.0

Version Date: May 2007



3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

Network Reference Model for CDMA2000 Spread Spectrum Systems

Revision B

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PREFACE

This 3GPP2 Wireless Network Reference Model depicts circuit-mode and packet-mode operation.

REVISION HISTORY

Revision	Date	Description
0	June 1999	Initial publication.
A	December 1999	<ul style="list-style-type: none"> — Update OAM&P elements to agree with PN-4108 — Added packet data network elements, rearranged several network elements — Updated ME&MS elements to agree with definitions in PN-4582
B v1.0	March 2000	<ul style="list-style-type: none"> — Recommended changes from TR45 NAG added — Added PCF — Added HA — Add PN4463 Changes — Corrected U_v label on fig 2.1
B v.2.0	May 2007	<ul style="list-style-type: none"> — Reverse transposed (i.e. TIA to 3GPP2) TIA TSB-100-A-1 — Updated the document with WPS references — Removed reference to IS-816 because IS-816 was never published. IS-816, for the U_v reference point, was to have been a transposition of IDB Forum (www.idbforum.org) developed spec IDB-0008-0B ITS Data Bus Phone Application Message.

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1. PURPOSE AND SCOPE

This document recommends the basic 3GPP2 Wireless Network Reference Model.

1.1 Informative References

MAP

- 3GPP2 X.S0004-E, *Mobile Application Part (MAP)*, April, 2004.

ANSI-93

- TIA/EIA-93-B-1, *Cellular Radio Telecommunications Ai - Di Interface Standard*, April 2006.

CDMA

- 3GPP2 C.S0001-A, Introduction for cdma2000 Spread Spectrum Systems, June 2000.
- 3GPP2 C.S0002-A, Physical Layer Standard for cdma2000 Spread Spectrum Systems, June 2000.
- 3GPP2 C.S0003-A, Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems, June 2000.
- 3GPP2 C.S0004-A, Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems, June 2000.
- 3GPP2 C.S0005-A, Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems, June 2000.
- 3GPP2 C.S0006-A, *Analog Signaling Standard for cdma2000 Spread Spectrum Systems, June 2000.*
- 3GPP2 C.S0016-0, *Over-The-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems*, December 1999.

DMH

- 3GPP2 X.S0014-E v1.0 Wireless Radio Telecommunications Intersystem Non-Signaling Data Communications DMH (Data Message Handler), February, 2005.

ANSI-136

- TIA/EIA-136-B, *TDMA Third Generation Wireless, Rev. B*, March 2000.

ANSI-553

- TIA/EIA-553-A, *Mobile Station - Land Station Compatibility Specification*; November 1999.

CDMA_DSIWF

- TIA/EIA/IS-658, *Data Services Interworking Function Interface for Wideband Spread Spectrum Systems*, July, 1996.
- TIA/EIA/IS-658-1, *Data Services Interworking Function Interface for Wideband Spread Spectrum Systems - Addendum 1*, April, 1999.

<i>CDMA_OTA</i>	1
• TIA/EIA/IS-683-A, <i>Over-The-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems</i> , June 1998.	2
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<i>ISLP</i>	5
• 3GPP2 N.S0019, <i>Intersystem Link Protocol</i> , January, 2000	6
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<i>IS-756</i>	9
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<i>IS-771.</i>	13
• TIA/EIA/IS-771, <i>Wireless Intelligent Network</i> , July 1999.	14
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<i>IS-788</i>	16
• TIA/EIA/IS-788, <i>Connector Specification for the Portable Phone Interface</i> , June 1999.	17
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<i>IS-789</i>	20
• TIA/EIA/IS-789-A, <i>Electrical Specification for the Portable Phone to Vehicle Interface</i> , April, 2000.	21
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<i>CDMA_UIM</i>	24
• 3GPP2 C.S0023-B v1.0, <i>Removable User Identity Module (R-UIM) for cdma2000 Spread Spectrum Standards</i> , May 2004.	25
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<i>WIN_PPC</i>	28
• 3GPP2 N.S0018, <i>Wireless Intelligent Network Capabilities for Pre-Paid Charging</i> , July 2000	29
	30
	31
<i>CDMA_IP</i>	32
• 3GPP2 X.S0011-D, <i>cdma2000 Wireless IP Network Standard</i> , March, 2006.	33
	34
	35
<i>TDMA_UIM</i>	36
• TIA/EIA/IS-136-030–037, <i>R-UIM Overview, Operation and File Structure Support</i> , October, 2001.	37
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<i>IOS</i>	40
• 3GPP2 A.S0001, <i>3GPP2 Access Network Interfaces Interoperability Specification</i> , June 2000.	41
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<i>WPS</i>	45
• TIA-917, <i>Wireless Priority Service Enhancements for CDMA Systems</i> , December 2004.	46
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	48
<i>ITU</i>	49
• M.3100, <i>Generic Network Information Model</i> , July 1995.	50
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<i>J-STD-025</i>	52
• TIA/EIA/J-STD-025, <i>Lawfully Authorized Electronic Surveillance</i> , 2000.	53
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<i>J-STD-036</i>	55
• TIA/EIA/J-STD-036, <i>Wireless Enhanced Emergency Services</i> , 2000.	56
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MAP_GSM

- 3GPP2 N.S0028, *Network Interworking between GSM MAP and ANSI-41 MAP*, April 2002

IETF

- RFC 2661, *Layer Two Tunneling Protocol L2TP*, 1999.
- RFC 2868, *RADIUS Attributes for Tunnel Protocol Support*, 2000.

3GPP

- TS 29.002, *Mobile Application Part (MAP)*. 2004.
- TS 29.060, *General Packet Radio Service (GPRS); GPRS Tunneling Protocol (GTP) across the Gn and Gp interface*, 2004.
- TS 29.061, *Interworking between the Public Land Mobile Network (PLMN) supporting packet based service and Packet Data Networks (PDN)*, 2004.

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2. REFERENCE MODELS

Reference models are a graphical tool used to visualize, structure, and describe certain complex subjects. A few such models are widely used in the wireless standards.

2.1 Wireless Network Reference Model

Figure 2.1 presents the network entities and associated reference points that comprise a wireless network. The network entities are represented by squares, triangles and rounded corner rectangles; the reference points are represented by circles. The network reference model in this document is the compilation of several reference models currently in use in wireless standards.

Note the following:

- **The network reference model is a functional block diagram.**
- **A network entity represents a group of functions, not a physical device. For example, a Mobile Switching Center (MSC) is a physical device; it comprises frames, shelves, circuit packs, etc. The physical device may comprise a single network entity such as the MSC, or it may comprise some combination such as the MSC, the Visitor Location Register (VLR), the Home Location Register (HLR), and the Authentication Center (AC). The physical realization is an implementation issue; a manufacturer may choose any physical implementation of network entities, either individually or in combination, as long as the implementation meets the functional requirements. Sometimes, for practical reasons, the functional network entity is a physical device. The Mobile Station (MS) is an excellent example.**
- **A reference point is a conceptual point that divides two groups of functions. It is not necessarily a physical interface. A reference point only becomes a physical interface when the network entities on either side of it are contained in different physical devices.**
- **A “Collective Entity” contains encompassed network entities that are an instance of the collective.**
- **A “Composite Entity” contains encompassed network entities that are part of the composite.**

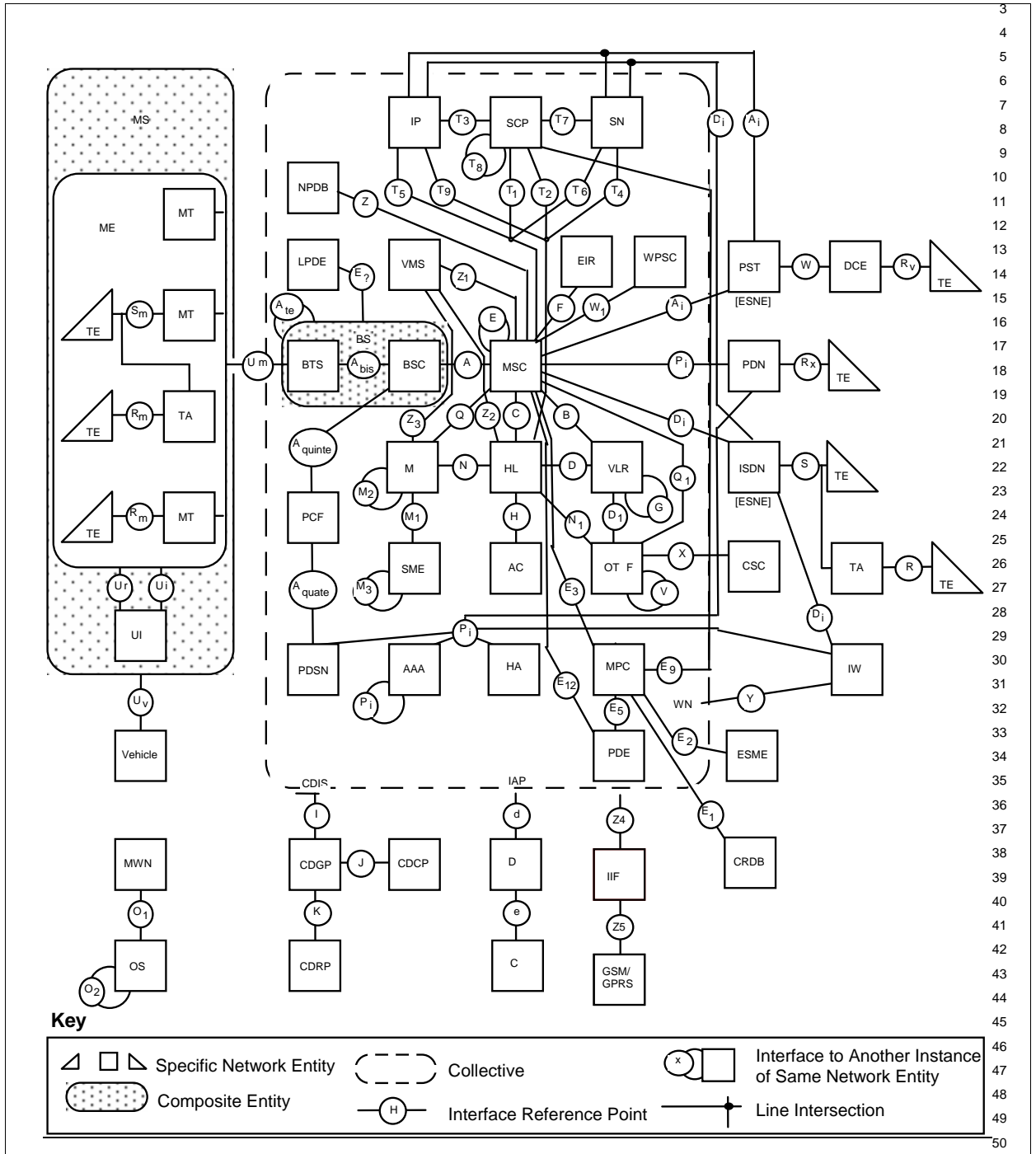


Figure 2.1 3GPP2 Wireless Network Reference Model

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1	AAA	Authentication, Authorization and Accounting	MC	Message Center
2				
3	AC	Authentication Center	ME	Mobile Equipment
4	BS	Base Station	MPC	Mobile Position Center
5	BSC	Base Station Controller	MS	Mobile Station
6	BTS	Base Transceiver System	MSC	Mobile Switching Center
7	CDCP	Call Data Collection Point	MT	Mobile Terminal
8	CDGP	Call Data Generation Point	MWNE	Managed Wireless Network Entity
9	CDIS	Call Data Information Source	NPDB	Number Portability DataBase
10	CDRP	Call Data Rating Point	OSF	Operations System Function
11	CF	Collection Function	OTAF	Over-The-Air Service Provisioning Function
12	CRDB	Coordinate Routing Data Base	PCF	Packet Control Function
13	CSC	Customer Service Center	PDE	Position Determining Entity
14	DCE	Data Circuit Equipment	PDN	Packet Data Network
15	DF	Delivery Function	PDSN	Packet Data Serving Node
16	EIR	Equipment Identity Register	PSTN	Public Switched Telephone Network
17				
18	ESME	Emergency Services Message Entity	SCP	Service Control Point
19	ESNE	Emergency Services Network Entity	SN	Service Node
20				
21	HA	Home Agent	SME	Short Message Entity
22	HLR	Home Location Register	TA	Terminal Adapter
23	IAP	Intercept Access Point	TE	Terminal Equipment
24	IIF	Interworking and Interoperability Function	UIM	User Identity Module
25				
26	IP	Intelligent Peripheral	VLR	Visitor Location Register
27	ISDN	Integrated Services Digital Network	VMS	Voice Message System
28				
29	IWF	Interworking Function	WNE	Wireless Network Entity
30	LPDE	Local Position Determining Entity	WPSC	Wireless Priority Service Center
31	LNS	L2TP Network Server		
32				
33				

2.1.1 Network Entities

Each Network Entity may be a physical device, may form part of a physical device, or may be distributed over a number of physical devices. See Section 2.1.2 for the definition of the Reference Points associated with each Network Entity.

Authentication, Authorization and Accounting (AAA)

The AAA is an entity that provides Internet Protocol functionality to support the functions of Authentication, Authorization and Accounting.

Authentication Center (AC)

The AC is an entity that manages the authentication information related to the MS. The AC may, or may not be located within, and be indistinguishable from an HLR. An AC may serve more than one HLR.

Base Station (BS)

A BS is an entity that provides the means for MSs to access network services using radio. It includes a BSC and a BTS.

Base Station Controller (BSC)

The BSC is an entity that provides control and management for one or more BTSs. The BSC exchanges messages with both the BTS and the MSC. Traffic and signaling concerned with call control, mobility management, and MS management may pass transparently through the BSC.

Base Transceiver System (BTS)

The BTS is an entity that provides transmission capabilities across the U_m reference point. The BTS consists of radio devices, antenna and equipment.

Call Data Collection Point (CDCP)

The CDCP is the entity that collects the *DMH* format call detail information.

Call Data Generation Point (CDGP)

The CDGP is an entity which provides call detail information to the CDCP in *DMH* format. This may be the entity which converts call detail information from a proprietary format into the *ANSI-124* format. All information from the CDGP to the CDCP should be in *ANSI-124* format.

Call Data Information Source (CDIS)

The CDIS is an entity that can be the source of call detail information. This information may be in proprietary format. It is not required to be in *DMH* format.

Call Data Rating Point (CDRP)

The CDRP is the entity that takes the unrated *DMH* format call detail information and applies the applicable charge and tax related information. The charge and tax information is added using *DMH* format.

Collection Function (CF) - [Intercept]

The CF is an entity that is responsible for collecting intercepted communications for a lawfully authorized law enforcement agency.

The CFs typically include:

- the ability to receive and process call contents information for each intercept subject.
- the ability to receive information regarding each intercept subject (e.g., call associated or non-call associated) from the Delivery function and process it.

Coordinate Routing Data Base (CRDB)

The CRDB is an entity which stores information to translate a given position expressed as a latitude and longitude to a string of digits.

Customer Service Center (CSC)

The CSC is an entity where service provider representatives receive telephone calls from customers wishing to subscribe to initial wireless service or request a change in the customer's existing service. The CSC interfaces proprietarily with the OTAF to perform network and MS related changes necessary to complete the service provisioning request.

Data Circuit Equipment (DCE)

A termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Delivery Function (DF) - [Intercept]

The DF is an entity that is responsible for delivering intercepted communications to one or more collection functions.

The DFs typically include:

- the ability to accept call contents for each intercept subject over one or more channels from each Access function.
- the ability to deliver call contents for each intercept subject over one or more channels to a Collection function as authorized for each law enforcement agency.
- the ability to accept information over one or more data channels and combine that information into a single data flow for each intercept subject.
- the ability to filter or select information on an intercept subject before delivery to a Collection function as authorized for a particular law enforcement agency.
- the optional ability to detect audio in-band DTMF digits for translation and delivery to a Collection function as authorized for a particular law enforcement agency.
- the ability to duplicate and deliver information on the intercept subject to one or more Collection functions as authorized for each law enforcement agency.
- the ability to provide security to restrict access.

Emergency Service Message Entity (ESME)

The ESME routes and processes the out-of-band messages related to emergency calls. This may be incorporated into selective routers (also known as Routing, Bridging and Transfer switches), public safety answering points, emergency response agencies, and Automatic Location Information (ALI) data base engines. The structure of the Emergency Service Network is beyond the scope of this document.

Emergency Service Network Entity (ESNE)

The ESNE routes and processes the voice band portions of the emergency calls. This is composed of selective routers (also known as Routing, Bridging and Transfer switches), public safety answering points and emergency response agencies. The structure of the Emergency Service Network is beyond the scope of this TSB. See J-STD-036.

Equipment Identity Register (EIR)

The EIR is an entity that is the register to which user equipment identity may be assigned for record purposes. The nature, purpose, and utilization of this information is an area for further study.

Global System for Mobile Communications (GSM) Mobile Application Part (MAP)

The network supporting GSM and Wideband CDMA radio systems.

Home Agent (HA)

The HA is an entity that:

- authenticates Mobile IP registrations from the MS.
- redirects packets to the foreign agent component of the PDSN, and optionally receives and routes reverse packets from the foreign agent component of the PDSN.
- may establish, maintain and terminate secure communications to the PDSN.
- receives provisioning information from the AAA Function for users.
- may assign a dynamic home IP address.

Home Location Register (HLR)

The HLR is the location register to which a user identity is assigned for record purposes such as subscriber information (e.g. Electronic Serial Number (ESN), Mobile Directory Number (MDN), Profile Information, Current Location, Authorization Period).

Integrated Services Digital Network (ISDN)

The ISDN is defined in accordance with the appropriate *ANSI T1* Standards.

Intelligent Peripheral (IP)

The IP is an entity that performs specialized resource functions such as playing announcements, collecting digits, performing speech-to-text or text-to-speech conversion, recording and storing voice messages, facsimile services, data services, etc.

Intercept Access Point (IAP)

The IAP is an entity that provides access to the communications to, or from, the equipment, facilities, or services of an intercept subject.

Interworking and Interoperability Function (IIF)

The network entity that interfaces between a GSM MAP network and a MAP network.

Interworking Function (IWF)

The IWF is an entity that provides information conversion for one or more WNEs. An IWF may have an interface to a single WNE providing conversion services. An IWF may augment an identified interface between two WNEs, providing conversion services to both WNEs.

L2TP Network Server (LNS)

LNS manages secure L2TP tunnels/sessions with the L2TP Access Concentrator and PPP sessions with the MS. It may authenticate the MS and assigns it an IP address.

Local Position Determining Entity (LPDE)

The LPDE facilitates determination of the position or geographical location of a wireless terminal. Each LPDE supports one or more position determining technologies. Multiple LPDEs using the same technology may serve the coverage area of an Mobile Position Center (MPC) and the multiple LPDEs each using a different technology may serve the same coverage area of an MPC. Local-PDEs (LPDEs) reside at the Base Station (BS). See J-STD-036 for details regarding the LPDE.

Managed Wireless Network Entity (MWNE)

A WNE or any specific network entity having Operations System wireless management needs, including another Operations System.

Message Center (MC)

The MC is an entity that stores and forwards short messages. The MC may also provide supplementary services for Short Message Service (SMS).

Mobile Equipment (ME)

A MS without a UIM. The ME is only capable of accessing the network for a locally defined service configuration (e.g., emergency services, service center).

Mobile Position Center (MPC)

The MPC selects a PDE to determine the position of a mobile station. The MPC may restrict access to position information (e.g., require that the MS be engaged in an emergency call or only release position information to authorized network entities).

Mobile Station (MS)

A wireless terminal used by subscribers to access network services over a radio interface. MSs include portable units (e.g., hand-held units), units installed in vehicles, and somewhat paradoxically, fixed location MSs. The MS is the interface equipment used to terminate the radio path at the subscriber. A MS is a ME with a programmed UIM.

Mobile Switching Center (MSC)

The MSC switches circuit mode MS originated or MS terminated traffic. An MSC is usually connected to at least one BS. It may connect to the other public networks (PSTN, ISDN, etc.), other MSCs in the same network, or MSCs in different networks. The MSC may store information to support these capabilities.

Mobile Terminal 0 (MT0)

A self-contained data capable ME termination that does not support an external interface.

Mobile Terminal 1 (MT1)

A ME termination that provides an ISDN user-network interface.

Mobile Terminal 2 (MT2)

A ME termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Number Portability DataBase (NPDB)

The NPDB is an entity which provides portability information for portable Directory Numbers.

Operations System Function (OSF)

The OSF is defined by the Telecommunications Management Network (TMN) OSF (see ITU M.3100). OSF functions include Element Management Layer (EML), Network Management Layer (NML), Service Management Layer (SML), and Business Management Layer (BML) functions spanning across all operations systems functions (e.g., Fault Management, Performance Management, Configuration Management, Accounting Management, and Security Management).

Over-The-Air Service Provisioning Function (OTAF)

The OTAF is an entity that interfaces proprietarily to CSCs to support service provisioning activities. The OTAF interfaces with the MSC to send MS orders necessary to complete service provisioning requests.

Packet Control Function (PCF)

The PCF is an entity in the radio access network that manages the relay of packets between the BS and the PDSN.

Packet Data Network (PDN)

A PDN, such as the Internet, provides a packet data transport mechanism between processing network entities capable of using such services.

1 **Packet Data Serving Node (PDSN)**

2
3 The PDSN routes MS originated or MS terminated packet data traffic. The PDSN
4 establishes, maintains, and terminates link layer sessions to MSs. The PDSN may
5 interface to one or more BSs and may interface to one or more PDNs.
6

7 **Position Determining Entity (PDE)**

8
9 The PDE facilitates determination of the position or geographical location of a wireless
10 terminal. Each PDE supports one or more position determining technologies. Multiple
11 PDEs using the same technology may serve the coverage area of an Mobile Position
12 Center (MPC) and the multiple PDEs each using a different technology may serve the
13 same coverage area of an MPC. See J-STD-036 for details regarding the LPDE.
14
15

16 **Public Switched Telephone Network (PSTN)**

17
18 The PSTN is defined in accordance with the appropriate *ANSI T1* Standards.
19
20

21 **Service Control Point (SCP)**

22
23 The SCP is an entity that acts as a real-time database and transaction processing system
24 that provides service control and service data functionality.
25

26 **Service Node (SN)**

27
28 The SN is an entity that provides service control, service data, specialized resources and
29 call control functions to support bearer-related services.
30
31

32 **Short Message Entity (SME)**

33
34 The SME is an entity that composes and decomposes short messages. A SME may, or
35 may not be located within, and be indistinguishable from, an HLR, MC, VLR, MS, or
36 MSC.
37

38 **Terminal Adapter (TA)**

39
40 An entity that converts signaling and user data between a non-ISDN and an ISDN
41 interface.
42
43

44 **Terminal Adapter m (TAm)**

45
46 An entity that converts signaling and user data between a non-ISDN and an ISDN
47 interface.
48
49

50 **Terminal Equipment 1 (TE1)**

51
52 A data terminal that provides an ISDN user-network interface.
53
54

55 **Terminal Equipment 2 (TE2)**

56
57 A data terminal that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT]
58 V series, ITU-T [CCITT] X series).
59
60

User Identity Module (UIM)

The UIM contains subscription information such as the NAM (Number Assignment Module) and may contain subscription feature information. The UIM may be integrated into the ME or the UIM may be removable.

Vehicle

The Vehicle is an entity in which the ME may be installed. The Vehicle may provide power, audio, antenna connections to the ME along with a control and user data gateway to vehicle based data networks.

Visitor Location Register (VLR)

The VLR is the location register other than the HLR used by an MSC to retrieve information for handling of calls to or from a visiting subscriber. The VLR may, or may not be located within, and be indistinguishable from an MSC. The VLR may serve more than one MSC.

Voice Message System (VMS)

The VMS stores received voice messages, data messages (e.g., email), or both message types and supports a method to retrieve previously stored messages. A VMS may also support (on a Directory Number basis) notification of the presence of stored messages and notification of a change in the number of voice messages, data messages, or both message types that are waiting retrieval.

Wireless Network Entity (WNE)

A Network Entity in the wireless Collective Entity.

Wireless Priority Service Center (WPSC)

The WPSC is an entity that stores and facilitates the management of the WPS priority level information for the WPS Users. The WPSC authorizes the WPS User and provides the priority level information for a WPS User call origination upon request from an MSC. The WPSC serves multiple MSCs. The WPSC is only applicable to the WPSC-based solution for WPS.

2.1.2 Reference Points

The U_m reference point is the only reference point that is by definition a physical interface. The other reference points are physical interfaces if network entities on either side of them are contained in different physical devices.

An interface exists when two Network Entities are interconnected through exactly one Reference Point.

Reference Point A

Reference Point A is the interface between the BSC and the MSC. See *IOS*.

Reference Point A_i

Reference Point A_i is the interface between the IP and the PSTN, plus the interface between the MSC and the PSTN [ESNE], plus the interface between the SN and the PSTN. See *ANSI-93*.

Reference Point A_{bis}

Reference Point A_{bis} is the interface between the BSC and the BTS.

Reference Point A_{quater}

Reference Point A_{quater} is the interface between the PDSN and the PCF. See *IOS*.

Reference Point A_{quinter}

Reference Point A_{quinter} is the interface between the BSC and the PCF. See *IOS*.

Reference Point A_{ter}

Reference Point A_{ter} is the BS to BS interface. See *IOS*.

Reference Point B

Reference Point B is the interface between the MSC and the VLR. See *MAP*.

Reference Point C

Reference Point C is the interface between the MSC and the HLR. See *MAP*.

Reference Point D

Reference Point D is the interface between the VLR and the HLR. See *MAP*.

Reference Point d

Reference Point d is the interface between an IAP and the DF. See *J-STD-025*.

Reference Point D₁

Reference Point D₁ is the interface between the OTAF and the VLR. See *MAP*.

Reference Point D_i

Reference Point D_i is the interface between:

- the IP and the ISDN,
- the IWF and the ISDN,
- the MSC and the ISDN [ESNE], plus
- the SN and the ISDN.

See *ANSI-93*.

Reference Point E

Reference Point E is the interface between the MSC and the MSC. See *MAP*.

Reference Point E₂

Reference Point E₂ is the interface between the MPC and the ESME. See *J-STD-036*.

Reference Point E₃

Reference Point E₃ is the interface between the MSC and the MPC. See *J-STD-036*.

Reference Point E₅

Reference Point E₅ is the interface between the MPC and the PDE. See *J-STD-036*.

Reference Point E₉

Reference Point E₉ is the interface between the SCP and the MPC. See *MAP*.

Reference Point E₁₁

Reference Point E₁₁ is the interface between the CRDB and the MPC. See *J-STD-036*.

Reference Point E₁₂

Reference Point E₁₂ is the interface between the MSC and the PDE. See *J-STD-036*.

Reference Point E_?

Reference Point E_? is the interface between the BS and the Local-PDE (LPDE), this interface is beyond the scope of 3GPP2 recommendations. See *J-STD-036*.

Reference Point e

Reference Point e is the interface between the CF and the DF. See *J-STD-025*.

Reference Point F

Reference Point F is the interface between the MSC and the EIR.

Reference Point G

Reference Point G is the interface between the VLR and the VLR. See *MAP*.

Reference Point H

Reference Point H is the interface between the HLR and the AC. See *MAP*.

Reference Point I

Reference Point I is the interface between the CDIS and the CDGP. The operations supported by this interface are described in *DMH*.

Reference Point J

Reference Point J is the interface between the CDGP and the CDCP. The operations supported by this interface are described in *DMH*.

Reference Point K

Reference Point K is the interface between the CDGP and the CDRP. The operations supported by this interface are described in *DMH*.

Reference Point L

Reserved.

Reference Point M₁

Reference Point M₁ is the interface between the SME and the MC. See *MAP*.

Reference Point M₂

Reference Point M₂ is the MC to MC interface. See *MAP*.

Reference Point M₃

Reference Point M₃ is the SME to SME interface. See *MAP*.

Reference Point N

Reference Point N is the interface between the HLR and the MC. See *MAP*.

Reference Point N₁

Reference Point N₁ is the interface between the HLR and the OTAF. See *MAP*.

Reference Point O₁

Reference Point O₁ is the interface between an MWNE and the OSF.

Reference Point O₂

Reference Point O₂ is the interface between an OSF and the F.

Reference Point P_i

Reference Point P_i is the interface between:

- the AAA and the AAA,
- the AAA and the PDN,
- the IWF and the PDN,
- the MSC and the PDN, plus
- the PDSN and the PDN.

See *IS-835*.

Reference Point Q

Reference Point Q is the interface between the MC and the MSC. See *MAP*.

Reference Point Q₁

Reference Point Q₁ is the interface between the MSC and the OTAF. See *MAP*.

Reference Point R

Reference Point R is the interface between the TA and the TE2.

Reference Point R_m

Reference Point R_m is the interface between the TE2 and the TA_m plus the interface between the TE2 and the MT2.

Reference Point R_v

Reference Point R_v is the interface between the DCE and the TE2.

Reference Point R_x

Reference Point R_x is the interface between the PDN and the TE2.

Reference Point S

Reference Point S is the interface between the ISDN and the TE1.

Reference Point S_m

Reference Point S_m is the interface between the TE1 and the MT1 plus the interface between the TE1 and the TAM.

Reference Point T₁

Reference Point T₁ is the interface between the MSC and the SCP. See *MAP and WIN_PPC*.

Reference Point T₂

Reference Point T₂ is the interface between the HLR and the SCP. See *MAP and WIN_PPC*.

Reference Point T₃

Reference Point T₃ is the interface between the IP and the SCP. See *MAP and WIN_PPC*.

Reference Point T₄

Reference Point T₄ is the interface between the HLR and the SN. See *MAP and WIN_PPC*.

Reference Point T₅

Reference Point T₅ is the interface between the IP and the MSC. See *MAP and WIN_PPC*.

Reference Point T₆

Reference Point T₆ is the interface between the MSC and the SN. See *MAP and WIN_PPC*.

Reference Point T₇

Reference Point T₇ is the interface between the SCP and the SN. See *MAP and WIN_PPC*.

Reference Point T₈

Reference Point T₈ is the interface between the SCP and the SCP. See *MAP and WIN_PPC*.

Reference Point T₉

Reference Point T₉ is the interface between the HLR and the IP. See *MAP and WIN_PPC*.

Reference Point U_i

Reference Point U_i is the interface between the integrated UIM and the ME.

Reference Point U_m

Reference Point U_m is the interface between the BS and the MS, which corresponds to the air interface.

Reference Point U_r

Reference Point U_r is the interface between a the Removable-UIM and the ME. See *CDMA_UIM* and *TDMA_UIM*.

Reference Point U_v

Reference Point U_v is the interface between a the ME and the Vehicle. See *IS-788* and *IS-789*.

Reference Point V

Reference Point V is the interface between the OTAF and the OTAF. See *MAP*.

Reference Point W

Reference Point W is the interface between the DCE and the PSTN.

Reference Point W₁

Reference Point W₁ is the interface between the MSC and the WPSC.

Reference Point X

Reference Point X is the interface between the CSC and the OTAF. See *MAP*.

Reference Point Y

Reference Point Y is the interface between a Wireless Network Entity (WNE) and the IWF. See *IOS*.

Reference Point Z

Reference Point Z is the interface between the MSC and the NPDB. See *MAP*.

Reference Point Z₁

Reference Point Z₁ is the interface between the MSC and the VMS. See *MAP*.

Reference Point Z₂

Reference Point Z₂ is the interface between the HLR and the VMS. See *MAP*.

Reference Point Z₃

Reference Point Z₃ is the interface between the MC and the VMS. See *MAP*.

Reference Point Z₄

The interface between the MSC, HLR, MC, AAA, PDSN, etc. and the IIF. See *MAP_GSM*.

Reference Point Z₅

The interface between the GSM/GPRS networks and the IIF. .

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